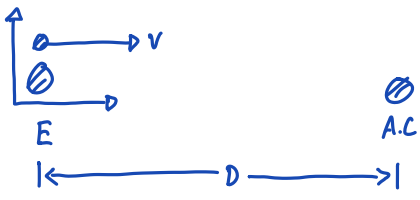
## CQ 1




$D = 4c$ years $\quad V = \frac{4}{5}c \quad V = \frac{D}{\Delta t} \quad \therefore \Delta t = \frac{D}{V} = \frac{4c \cdot \text{years}}{\frac{4}{5}c} = 4 \times \frac{5}{4}\text{ years} = 5\text{ yrs}$

5 yrs

## CQ 2

$$\Delta t = \frac{\Delta t'}{\sqrt{1-(v/c)^2}}$$

$$\Delta t' = \Delta t\left(\sqrt{1-(4/5)^2}\right) = 5\text{ yrs}\,(3/5) = 3\text{ yrs}$$

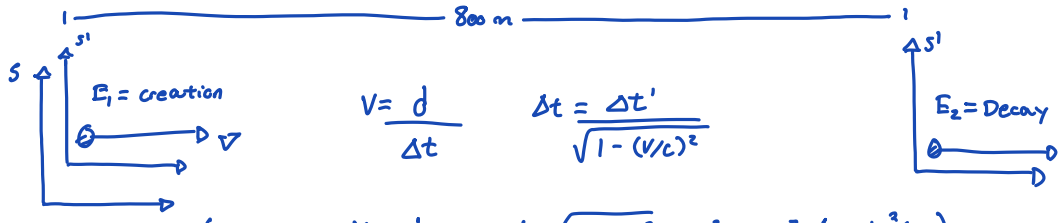
3yrs

## Ex Ch.4 P.3

$$v = \frac{d}{t}$$

muon lives at $t = 2.0\times10^{-6}$ s

$d = 800$ m




$$V = \frac{d}{\Delta t} \qquad \Delta t = \frac{\Delta t'}{\sqrt{1-(v/c)^2}}$$

$$V = \frac{d}{\Delta t} = \frac{d}{\Delta t'}\sqrt{1-(v/c)^2} = \frac{v^2}{c^2} = \frac{d^2}{c^2\Delta t^2}\left(1 - v^2/c^2\right)$$

$$\frac{v^2}{c^2}\left(1+\left(\frac{d}{c\Delta t}\right)^2\right) = \frac{d^2}{c^2\Delta t'^2} \qquad \frac{V}{c} = \frac{d/c\Delta t'}{\sqrt{1+(d/c\Delta t')^2}} = \frac{4/3}{\sqrt{1+(4/3)^2}} = \frac{4/3}{4/3} = 4/5$$

## Length Contraction

Transverse lengths are unaffected by motion ↕

Longitudinal lengths are affected by motion ↔

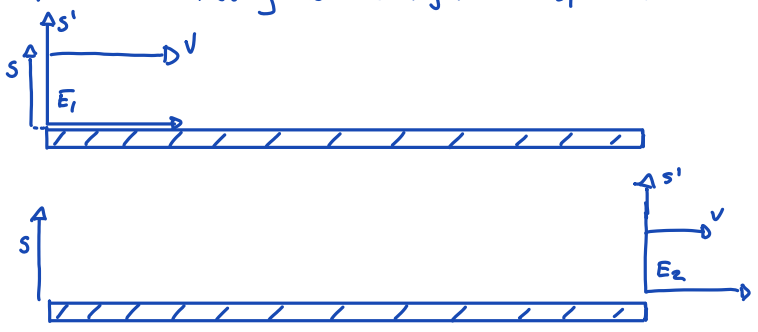
$E_1$: S' observer passes left end of stick — S is in the rest frame relative to the stick

$E_2$: S' observer passes right end of stick — S' moving relative to stick; S' observers $\Delta x' = 0$

$V = D/t \quad \therefore \Delta t = D/V \qquad \Delta t' = \Delta t \cdot \sqrt{1-(v/c)^2} < \Delta t$

$\Delta t' = \frac{D}{V}\sqrt{1-(v/c)^2}$

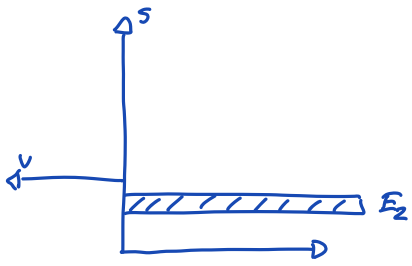
Consider a length of capital D, at rest in our frame, w/ a clock moving to the right w/ speed V

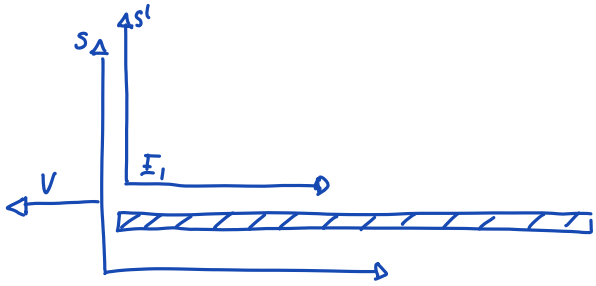



moving clocks run slow

Notice:

- Both events happen at the same $x'$ position. $\Delta x' = 0$
- $S'$ is @ rest, $S$ is moving to the left @ speed $V$




$$d = V\Delta t' \cdot \frac{D}{V}\sqrt{1-(V/c)^2}$$

$$d = D\sqrt{1-(V/c)^2} < D$$

The reference frame relative to the object measures a shorter length.